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PROVISIONAL INTELLIGENCE REPORT

PRODUCTION AND CONSUMPTION OF ALUMINUM IN THE SOVIET BLOC

CIA/RR PR-22

(ORR Project 58-51)

5 February 1953

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(ORR Project 58-51)

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SECURITY INFORMATION

PRODUCTION AND CONSUMPTION OF ALUMINUM IN THE SOVIET BLOC*

Summary

Aluminum is a metal of major importance to the Soviet Bloc because of its extensive use in the manufacture of aircraft and weapons as well as in war-supporting industries. In an effort to build up an aluminum reserve, the USSR has been increasing its own production of aluminum as well as building up the production of the Satellite countries. With the initiation of COCOM (Coordinating Committee on East-West Trade) and the passing of the Battle Act of 1951 it has become difficult for the Soviet Bloc to import aluminum. In a further effort to increase the reserve, the USSR has insisted on the inclusion of even small amounts of aluminum imports as a prerequisite to many trade agreements. There is evidence that the Soviet Bloc also has been importing aluminum illegally.

Although there are no shortages of the raw materials for producing aluminum in the USSR, its own deposits are neither high-grade nor located near good transportation, and the USSR imports high-grade bauxite from Hungary. The use of thermally generated electric power tends to make the cost of Soviet Bloc aluminum high. Upon the completion of hydroelectric generating stations, the cost probably will be reduced.

Aluminum is produced in the USSR in seven plants, with the two largest at Kamensk-Ural'skiy and Krasnotur'insk in the Urals area. Others are located at Kandalaksha, Volkhov, Zaporozh'ye, Yerevan, and Stalinsk. Reports indicate that an additional plant is under construction at Cherepovets, north of Moscow, and that an alumina reduction plant is planned in the Angara River region in Eastern Siberia.

Aluminum production in the Satellite countries is increasing. It is believed that aluminum is being produced in East Germany at Bitterfeld; in Hungary at Tatabanya, Ajka, and Inota; and in China at Chang-Tien and that plants are planned for Czechoslovakia, Rumania, and Poland.

Estimated production of primary aluminum in the USSR for the fiscal year 1952-53 is 232,500 metric tons, and the planned objective for 1955

* This report contains information available to CIA as of 1 June 1952.

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is 440,000 metric tons. The production of aluminum for the Soviet Bloc in the fiscal year 1952-53 is estimated to be 279,100 metric tons of primary aluminum and 20,900 metric tons of old-scrap (worn-out machinery and other items),* and it is estimated that the 1955 production of aluminum in the Soviet Bloc will be 575,000 metric tons of primary aluminum and 619,000 metric tons of primary aluminum and old scrap.

Legal shipments of aluminum in 1951 from COCOM countries to the Soviet Bloc amounted to more than 4,500 metric tons. The Soviet Bloc has insisted on the inclusion of even relatively small amounts of aluminum imports as a prerequisite to ratification of trade agreements. Illegal shipments in the fiscal year 1951-52 amounted to approximately 11,000 metric tons.

It is estimated that the Soviet Bloc will be able to allocate about 87,500 metric tons of aluminum to their metal reserves in the fiscal year 1952-53 and that the total reserve in June 1953 will be 382,500 metric tons.

Consumption of aluminum by the military segment of the Soviet Bloc is estimated to be almost 44 percent of total consumption. War-supporting industries are estimated to account for almost 35 percent, leaving 21 percent for other uses.

Since about 75 percent of Soviet Bloc primary aluminum is produced by thermally generated power, it is believed that the generating plants, as well as transmitting, switching, and rectifying electrical equipment, are the most vulnerable segment of the Soviet Bloc aluminum industry.

It is concluded that the Soviet Bloc is currently producing enough aluminum to meet essential military requirements, to supply its war-supporting industries, to supply household and other requirements, and to allow enough for addition to the metal reserves. The legal and illegal purchases of aluminum and reports of aluminum shortages within the Bloc, as well as announced plan objectives, indicate that additional aluminum is needed by the Bloc to meet fully its requirements, including planned reserves.

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* New scrap, generated during manufacture and returning to manufacture, is not counted as production in this report.

I. Introduction.

Aluminum is a light-weight metal with a specific gravity of 2.70, weighing 167 pounds per cubic foot, a little more than one-third as much as steel. On exposure to air it assumes a bluish tinge because of the formation of oxides on the surface. Once formed, these oxides tend to prevent further oxidation. Aluminum is never found in nature in its metallic form. Alumina is aluminum oxide (Al_2O_3) and may be produced from bauxite by removing impurities and confined water.

Primary aluminum is also called virgin aluminum and is defined as aluminum extracted from its ores. Commercial-grade primary aluminum extracted from alumina ranges from about 95 to 99.5 percent pure, depending on the purity of the materials used and the efficiency of the manufacturing process. Aluminum of higher purity approximating 99.99 percent may be prepared but is in little demand except for special purposes such as rolling of foil.

Secondary aluminum (scrap aluminum) is divided into (1) new scrap, which is metal of known composition such as punchings, clippings, turnings, and rejects from manufacturing operations and (2) old scrap, which is such metal as worn-out engine parts and obsolete or broken objects.

Bauxite is an earthy mineral, having the theoretical composition of aluminum oxide, plus one to three molecules of combined water. The dihydrate form of bauxite theoretically contains 74 percent alumina. High-grade bauxite contains at least 55 percent alumina, the balance being water, silica, iron oxide, and smaller amounts of other impurities. Bauxite containing under 50 percent alumina is considered to be low-grade.

II. Methods and Processes of Production.

The usual practice for production of aluminum from aluminous minerals involves (1) the extraction of alumina from the ore (usually bauxite) and (2) the reduction of alumina to aluminum by electrolysis. After reduction the aluminum is further processed by alloying with other metals, by casting, forging, rolling, or other working processes, and by extrusion. These last processes result in the so-called semifabricated products, such as sheets and ingots, which are further processed and fabricated into finished manufactured parts, components, and articles.

A. Extraction of Alumina.

1. Bayer Process.

Extraction of alumina from ore is classically done by the Bayer process, in which calcined bauxite is ground in ball mills and then mixed with caustic soda solution in a stirring tank. The mixture is then placed in steam-jacketed autoclaves and heated for several hours, the temperature used depending on the composition of the ore. The trihydrate form of bauxite is more soluble than the monohydrate form, since the former goes into solution at just over the boiling point at atmospheric pressure, and the latter requires up to 180°C and a more concentrated caustic soda solution. 1/* European bauxites are essentially of the monohydrate type. 2/. In either case the recoverable alumina is dissolved in the form of sodium aluminate, which solution is settled, filtered, seeded with aluminum hydroxide, and allowed to stand for several days. The precipitated aluminum hydroxide is recovered by filtration and calcined in tubular rotary kilns at 1,000°C to 1,100°C, yielding alumina of 98 to 99.5 percent purity. Impurities are typically 0.7 percent water, 0.1 percent silica, and 0.1 percent iron oxide. The red mud remaining after decanting and filtering the sodium aluminate may contain considerable alumina if the original bauxite was high in silica, since each pound of silica combines with 1 to 2 pounds of alumina and 1/2 to 1-3/4 pounds of sodium oxide in such compounds as $2Na_2O$ (sodium oxide), $2Al_2O_3$ (aluminum oxide), $3SiO_2$ (silicon dioxide). 3/ The red mud may be sent to waste or may be reworked by the soda-lime-sinter process described below. It is believed practically all the alumina in the USSR and European Satellites is being produced by the Bayer process at this time.

2. Soda-Lime-Sinter Process.

The soda-lime-sinter process has been used in conjunction with the Bayer process in treatment of ores containing up to 13 percent silica (7 percent was formerly considered to be the maximum allowable) and for extracting alumina from red mud residues. For treatment of these residues, the red mud is sintered with soda ash and lime in large calcining kilns. The alumina is dissolved in the form of sodium aluminate, which is leached from the residue and precipitated in the same manner as the original Bayer solutions. 4/ Modifications of this process

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* Footnote references in arabic numerals are to sources listed in Appendix C.

have been used in the USSR for recovering alumina from low-grade bauxites. The soda-lime-sinter process also can be used directly on low-grade ores such as aluminous clays and may be the basic process used for production of alumina in China.

3. Tower Process.

This process was introduced at Lippwerke in Germany during World War II and is being installed in Yugoslavia at the present time for production of alumina for the Strnisce plant. 5/ Part of the alumina production of the Lautawerk plant, which was dismantled and shipped to the USSR, was obtained by means of the Tower process. 6/ Hence the process is well known in the USSR and may be used, particularly in the future, for alumina production. In this process, coarsely ground, calcined bauxite is continuously treated at 180°C with caustic soda solution in tall towers. By using calcined ore and working countercurrently, a high alumina content is reached. The ratio of sodium oxide to alumina is 1 to 4 for the Tower process as against 1 to 9 for the Bayer process. By this innovation, less liquid and hence less heat are required, and no thickening is needed. Capital costs and labor are also less. Bauxite higher in silica than is acceptable for the Bayer process may be used. 7/ Treatment after solution of the alumina is essentially the same as for the Bayer process.

4. Pedersen Process.

The Pedersen process extracts both iron and alumina from bauxites. In this process, bauxite and limestone are smelted together and form iron and a calcium aluminate slag. The slag is then leached with soda ash and caustic soda solution. Alumina is precipitated partly with sodium hydroxide seed and partly with carbon dioxide. 8/ It is believed that this process, or a modification of it, was used in the USSR at the Zaparozh'ye aluminum plant 9/ but was abandoned after high-grade bauxite became available. 10/

5. Alumina from Alunite.

Alunite (hydrous potassium aluminum sulphate) can be treated to yield alumina by several processes, including the Kalunite and Moffat processes and Japanese processes. Production of alumina from alunite was proposed in Azerbaydzhan SSR to supply the Yerevan Aluminum Plant, 11/ but there is doubt that the proposed alunite-alumina plant was ever constructed. Bauxite shipments from Hungary over the Black Sea have been reported 12/ and could well be supplying the Yerevan plant. In the

US, during World War II, alunite was considered to be a source of alumina because much of the US bauxite reserves are of low grade. In spite of this, alunite was never successfully utilized as a source of alumina, and US postwar production of alumina is almost entirely from bauxite.

6. Recovery from Nephelite.

In the Kola Peninsula area of the USSR there are huge deposits of apatite (a phosphate mineral utilized for the production of fertilizers) associated with nephelite. The analysis of the nephelite averages 30 percent aluminum dioxide, 42 percent silicon dioxide, 2 to 2.5 percent iron oxide, 2 to 2.5 percent calcium oxide, 5 to 6 percent potassium oxide, 12 to 13 percent sodium oxide, and 0.5 to 0.7 percent phosphorus pentoxide. In the late 1930's, material input requirements of alumina produced from nephelite were high (8 to 10 tons of lime and 4.5 tons of coal per ton of produced alumina), and it is believed the project was abandoned. 13/

7. Materials Requirements for the Production of Alumina.

Table 1* indicates materials input requirements of various ores and processes for the production of alumina. The grade of bauxite processed has a tremendous influence on the amount of materials needed for producing alumina. To produce 1 metric ton of alumina, bauxite containing 61 percent alumina and 2 percent silica requires only 1.88 metric tons of reagents (omitting the coal required for heat) as compared with 3.33 metric tons for bauxite containing 51 percent alumina and 14 percent silica. In addition, the requirements for coal, labor, and capital equipment are greater for the lower-grade bauxite.

Relatively large materials requirements are indicated for the soda-lime-sinter and nephelite processes.

In the USSR the originally used Tikhvine ores analyzed only about 48 percent alumina and 10 to 20 percent silica. Hence input requirements were high for this ore. The North Urals ores supplying Krasnotur'insk and Kamensk-Ural'skiy reportedly contain 56 percent alumina and 3.7 percent silica, 14/ and inputs would be correspondingly less. Hungarian bauxite is high-grade, the material being shipped to the USSR having a ratio of alumina to silica of 13 or 14 to 1, 23/ and would be much cheaper to process than the Tikhvine ores.

* Table 1 follows on p. 7

Table 1

Input Requirements for Producing One Metric Ton of Alumina

Metric Tons

	Bayer Process US 15/ a/ *	Bayer Process US 16/ b/	Bayer Process Germany 17/ c/	Bayer Process Japan 18/ c/	Soda-Lime-Sinter Process 19/	Nephelite Process USSR 20/	Bayer Process Tikhvine Bauxite c/ USSR 21/
Bauxite	2.89	1.76	1.80 - 2.00	2.250 d/	0	0	N.A.
Soda Ash	0.44	0.07	0	0	0.038	N.A.	N.A.
Lime	0.30	0.05	e/	e/	0	8.0 - 10.0	N.A.
Caustic Soda	0	0	0.15	0.147	0	N.A.	N.A.
Coal, Bituminous	1.00 - 2.00	1.00 - 2.00	1.50 - 2.50	0.726 f/	2.600	4.5	N.A.
Raw Clay, 35 percent Al_2O_3	0	0	0	0	3.200	0	0
Limestone, Dry, 54 percent CaO	0	0	e/	e/	7.500	0	N.A.
Nephelite, 30 percent Al_2O_3	0	0	0	0	0	3.3	0
Materials Total	4.63 - 5.33	2.88 - 3.88	3.45- 4.65	N.A.	13.338	15.8 -17.8 g/	6.1 22/
Electric Power, KWH	180	180	N.A.	2,019 h/	970	N.A.	N.A.

* Footnotes to Table 1 follows on p. 8.

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Table 1

Input Requirements for Producing One Metric Ton of Alumina
(Continued)

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a. Analysis of bauxite 51 percent Al_2O_3, 14 percent SiO_2.
b. Analysis of bauxite 61 percent Al_2O_3, 2 percent SiO_2.
c. Analysis of bauxite not available.
d. Converted from reported 1.181 tons Al_2O_3, content in bauxite per ton alumina produced, assuming bauxite contains 55 percent Al_2O_3.
e. Information as to whether lime or limestone is used is not available.
f. Includes weight of heavy oil used.
g. The total input requirements for the nephelite process in the USSR has been reported to be 12.5 metric tons. 2/
h. Includes electricity for production of all reagents.

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B. Reduction of Alumina.

1. Hall-Heroult Process.

The commonly used method for production of aluminum from alumina at present is essentially the same as the original process developed independently by Hall in the US and Heroult in France about 1886. In this process, alumina is dissolved in melted cryolite, the alumina then being disassociated into primary aluminum and oxygen by an electric current conducted into the molten bath by carbon electrodes. The aluminum settles to the bottom of the molten bath and is periodically removed and cast into pigs. The oxygen escapes and combines with carbon in the electrodes. The electrolytic bath is lined with carbon which acts as the negative electrode and which also is nonreactive to molten aluminum and to the bath. Carbon linings last as long as 2 years if carefully made, but once flaws or cracks develop, the electrolytic cell soon shorts out, and the unit then must be shut down while the carbon lining is replaced.

2. Materials Requirements for the Reduction of Alumina.

The production of aluminum from alumina requires 2 metric tons of alumina per metric ton of aluminum produced and, in addition, approximately 0.5 metric ton of a relatively pure carbon such as petroleum coke, 0.15 metric ton of pitch for binder, and 0.025 to 0.03 metric ton of both cryolite and aluminum fluoride for fluxes. In addition, a tremendous amount of electrical energy is required, ranging from 20,000 to 25,000 kilowatt-hours (kwh) per metric ton of aluminum.

III. Production and Supply of Aluminum in the Soviet Bloc.

A. Production.

1. Primary Aluminum.

Estimates of the production of primary aluminum in the Soviet Bloc are summarized in Table 2,* which covers production estimates for the years 1948 to the fiscal year 1952-53 and anticipated production for 1955.

a. USSR.

(1) General.

Aluminum in the USSR is produced by means of expensive thermally generated electric power at Kamensk-Ural'skiy,

* Table 2 follows on p. 10.

Table 2

Estimated Production of Primary Aluminum in the Soviet Bloc
1948-55

Thousand Metric Tons

Country	1948	1949	1950	1951	Fiscal Year 1952-53	1955
USSR 24/	135.0	155.0	170.0	200.0 a/	232.5 a/	440.0 b/
Hungary c/	9.4	14.0	N.A.	22.0 d/	32.6	42.0 d/
East Germany e/	0	0	0	5.0	12.5	25.0 d/
Czechoslovakia	0	0	0	0	0	40.0 d/
Rumania	0	0	0	0	0	5.5 d/
Poland	0	0	0	0	0	18.0 d/
China f/	0	0	0	1.5	1.5	5.0
Total	144.4	169.0	170.0	228.5	279.1	575.5

a. Based on Fourth Five Year Plan (2.6 times 1950 production by 1955).
b. Accuracy estimated to be correct within the range of plus 5 percent to minus 20 percent.
c. Estimated to be accurate up to 1951 within plus or minus 10 percent, and for 1951 within plus 5 percent to minus 25 percent.
d. Based on defector reports for the European Satellite countries.
e. Estimated to be accurate within plus or minus 25 percent.
f. No estimate of accuracy can be made.

Krasnotur'insk, and Stalinsk, and possibly partly by thermally generated electric power at Zaporozh'ye, where industrial demands may have outstripped the available hydroelectric power resources. Hence, probably three-fourths of the aluminum produced in the USSR is reduced from alumina by thermally generated electric power, which is basically higher in cost than hydroelectric power.

Mines in the Northern Urals area at Severoural'sk 25/ are believed to be in operation supplying the plant at Krasnotur'insk and possibly the plant at Kamensk-Ural'skiy. The Stalinsk plant also is obtaining its bauxite locally. 26/ It is believed, however, that some of the USSR aluminum plants use imported bauxite. Total USSR bauxite reserves have been estimated at 28 million to 62 million metric tons. 27/ The economically recoverable quantity is about 40 million metric tons of which about 10 million to 15 million metric tons are considered to be high-grade bauxites. In the USSR, low-grade Tikhvine bauxites, which would be considered uneconomical in the US, have been used. The exploitation of Hungarian bauxite tends to decrease this weakness of the USSR, but the long hauls by land transportation make Hungarian bauxite expensive.

There do not appear to be basic shortages of any of the items used in the production of aluminum. Supplying these items to the aluminum industry, however, is thought to put a strain on the Soviet economy.

No details on the planned expansion of aluminum production in the USSR are available, except that the water power resources of the Angara River are to be used for the aluminum industry. 28/ The Angara River drains Lake Baikal in East Siberia. Since the Fifth Five Year Plan states that work on tapping the power resources of the Angara River is to be started during the 1950-54 period, it seems doubtful that the hydroelectric projects could be completed and aluminum reduction facilities installed to the extent that much of the proposed production increase could be achieved in this area. An aluminum reduction plant is also reportedly under construction at Cherepovets, Vologda Oblast. 29/

(2) Plants.

Production of primary aluminum in the USSR by plants and economic regions is estimated in Table 3.*

* Table 3 follows on p. 12.

Table 3

Estimated Annual Production of Primary Aluminum in the USSR 30/
July 1952

Thousand Metric Tons

Economic Region*	Location of Plant	Annual Production Rate	Regional Annual Total
Ia			30
Murmansk Oblast	Kandalaksha	20	
Leningrad Oblast	Volkhov	10	
III			
Ukraine SSR	Zaporozh'ye	25	
V			10
Armenian SSR	Yerevan	10	
VIII			130
Sverdlovsk Oblast	Kamensk-Ural'skiy	70	
Sverdlovsk Oblast	Krasnotur'insk	60	
IX			30
Kemerovo Oblast	Stalinsk	30	
Total			225

* Economic regions are as outlined in CIA map "USSR Economic Regions," 12048 CIA 9-51.

b. Satellites.

(1) General.

(a) Hungary.

Hungary possesses some of the largest and best bauxite deposits in the world. The reserves are reported to have produced over more than 250 million metric tons in 1938. 31/ The deposits, which are located in the Vertes, Bakony Hegyseg, Nagy Harsany, and the Borzsonyi Hegyseg mountains, are near good transportation and are easy to mine. It is believed that Hungary is supplying about 800,000 metric tons of bauxite to the USSR each year, 32/ by way of barges loaded at Komaron or Budapest and unloaded at Ismaili or Reni, from where it is shipped by rail or boat into the USSR. 33/

This amount of bauxite is more than 70 percent of the estimated total bauxite requirements for every purpose in the USSR. Hungary is thus reportedly supplying approximately one-half of the total estimated European Soviet Bloc requirements of bauxite. The bauxite is reportedly of high purity, with a ratio of alumina to silica of 13 or 14 to 1. 34/

Hungary is deficient in electrical energy developed from waterpower and is dependent on outside sources for most of the other inputs into the aluminum industry. Much increase over the proposed 1955 production of aluminum is not anticipated.

(b) East Germany.

At the end of World War II, almost all of the aluminum production equipment in East Germany was dismantled and shipped to the USSR. East Germany still retains the technical ability to produce alumina and aluminum but has no native sources of bauxite and is short of electrical energy. Bauxite is to be supplied to East Germany from Hungary. Original reported plans for East Germany called for over 30,000 metric tons of primary aluminum in the 1952-53 period. 35/ These plans have reportedly been considerably reduced because of capital requirements 36/ and shortages of raw materials. 37/

(c) Other European Satellites.

As indicated in Table 2, anticipated aluminum production for 1955 includes production in Czechoslovakia and Rumania. Bauxite for Czechoslovakia is reportedly to be shipped from Hungary, 38/ and Rumania is to be supplied with domestic ore. 39/ In neither country is there sufficient cheap power available, and it appears that the building of the aluminum industry in these countries follows the Soviet pattern of making the Satellite countries independent of Soviet exports to the greatest extent possible.

(d) China.

Little is known of the Chinese aluminum industry since China was taken over by the Communists. There are large reserves of aluminum ore, but cheap power appears to be deficient.

(2) Plants.

Aluminum production in the Satellites as of July 1952 is believed to be distributed as shown in Table 4.*

* Table 4 follows on p. 14.

Table 4

Estimated Annual Production of Primary Aluminum in the Satellite Countries
July 1952

Thousand Metric Tons

Country	Location of Plant	Production Rate	
East Germany	Bitterfeld	10.0	40/
Hungary	Tatabanya	11.0	41/
	Ajka	11.0	42/
	Inota	0	43/
Czechoslovakia	Svaty-Kriz nad Hronom	0 a/	44/
Rumania	Unknown	0 b/	45/
Poland	Krakow area	0 c/	46/
China	Chang-Tien d/	1.5	47/
Total		33.5	

a. Scheduled to start limited operations August or September 1952 with a planned capacity of 40,000 metric tons.
b. 5,500 metric tons planned by 1955.
c. 18,000 metric tons planned capacity.
d. Near Tsingtao-Tsinan Railroad.

2. Secondary Aluminum.

The Soviet press has stated that secondary aluminum production in the USSR amounts to over 30 percent of the aluminum produced in the USSR. 48/ This figure is believed to be fairly accurate and usable for estimation purposes for the entire Soviet Bloc, since it conforms reasonably well to recent data on Western production of secondary aluminum. In 1949, for example, the production of secondary aluminum in the US was slightly over 23 percent of the total US production of aluminum, 49/ and in 1950 was almost 25.5 percent of the total US aluminum produced. 50/ According to data compiled by the UN, the production of secondary aluminum in France, Germany, the UK, and the US in 1950 was one-third of the total aluminum production in these countries. 51/ By using the primary aluminum production figures in Table 2 and applying a 30-percent factor, the estimated secondary aluminum production in the Soviet Bloc for 1950 to 1955 is derived, as shown in Table 5.* Production for 1948 and 1949 was not calculated, since the percent factor may be higher because of remelting of war scrap.

* Table 5 follows on p.15.

Table 5

Estimated Production of Secondary Aluminum
in the Soviet Bloc 52/
1950-55

Thousand Metric Tons

1950	1951	Fiscal 1952-53	1955
51.0	68.5	83.7	172.7

In discussing the importance of secondary aluminum to the Soviet Bloc economy, the distinction between new and old scrap should be emphasized. (See Introduction.) Since consumption figures for various industries do not reflect the new scrap generated as being subtracted from the total consumption, consumption figures could be misleading. New scrap should be considered as material in a pipeline between the industrial consumer and producers of sheet aluminum or other semifabricated forms, and not as aluminum production. In the US in 1949, 75 percent of the secondary aluminum recovered was in the form of new scrap and 25 percent in the form of old scrap. 53/ This figure has been adopted for purposes of estimating Soviet production. For estimation purposes, a time lag of 6 months for scrap from newly produced aluminum to return to supply has been used. 54/

3. Total Production.

The estimated total of aluminum available to the Soviet Bloc, primary aluminum and old scrap, is given in Table 6.*

B. Imports.

1. Legal.

Official reports of COCOM (Coordinating Committee on East-West Trade) indicate that shipments by COCOM countries in 1951 totaled 4,589 metric tons plus an undetermined amount reported in value only. 56/ The COCOM countries attempt to keep aluminum from the Soviet Bloc, but

* Table 6 follows on p. 16.

Table 6

Estimated Total a/ Aluminum Produced in the Soviet Bloc Excluding New Scrap 55/
1950-55

Thousand Metric Tons

1950	1951	Fiscal 1952-53	1955
183	246	300	619

a. Total production is calculated as primary production plus old scrap. Old scrap is calculated as 0.30 x 0.25 x primary production. See above in text.

available information indicates that the Soviet Bloc has insisted on the inclusion of even relatively small amounts of aluminum imports as a prerequisite to ratification of trade agreements. For example, the Norwegian delegate to COCOM stated that inclusion of exports of aluminum to the USSR was necessary to obtain ratification of its trade agreement with that country. 57/ Another example of the emphasis the Soviet Bloc is placing on aluminum is the 1951 Polish-Austrian negotiations, in which Poland offered generous concessions for inclusion of exports by Austria of aluminum as a term of their trade agreement. Poland offered to reduce the price of Polish coal by $0.50 per metric ton in return for the inclusion by Austria of 500 metric tons of aluminum in the trade agreement. An additional reduction of $0.50 per metric ton was offered for each 500 metric tons of aluminum supplied. 58/ Since each reduction of $0.50 per metric ton would save Austria $500,000, the emphasis on importing aluminum is apparent.

There are reports of shipments of aluminum from non-COCOM Western countries to the Bloc. 59/ A total on these shipments is not available at this time. It is estimated, however, to be in the neighborhood of 1,000 metric tons per year.

2. Illegal.

With the initiation of COCOM 60/ in 1950 and of the Battle Act in 1951, 61/ many shipments of aluminum into the Soviet Bloc, which previously would have been merely normal import-export trade, either had to cease, or had to be done illegally. Many such illegal shipments have been detected, and the difficulties encountered in making these illegal purchases, as well as the higher prices paid and the additional transshipment charges incurred, indicate a great desire on the part of the Soviet Bloc to obtain aluminum, even in relatively small individual amounts.

Considering the reserve which the Soviet Bloc is believed to have accumulated, it might seem that the illegal purchases of the Satellites have not been made to build up the USSR reserve, but rather for Satellite production required by the USSR. The fact, however, that illegal shipments of aluminum into the Satellite countries must be paid for in hard cash, of which they are short, together with the emphasis which the USSR itself placed on purchases of Norwegian aluminum, indicates that the illegal shipments are actually purchased by Soviet agents. It is concluded that the USSR has decided that the Soviet Bloc needs the aluminum and is willing to devote the money and effort necessary to obtain it by illegal means. The position of the USSR appears to be not dissimilar to that of the US, which limits the use of aluminum and imports aluminum at prices above the world market price but still attempts to increase its reserves.

An estimate of the amount of aluminum illegally shipped into the Soviet Bloc during the fiscal year 1951-52 is approximately 11,000 metric tons. 62/ This figure is an estimate, and the figures used in its computation may contain a certain amount of duplication. The figure arrived at is, however, indicative of the fact that illegal trade is occurring. Since many illegal shipments may not have been detected, the actual figure may be considerably higher than the estimate given.

IV. Consumption of Aluminum in the Soviet Bloc.

A. Consumption by Industries.

Aluminum is vital to Soviet Bloc planning because of its extensive use in the construction of aircraft, guided missiles, engine parts, and other war material. It is also important to war-supporting industries because of its use in the deoxidation of steel, in the manufacture of electric power transmission cables, and as a substitute for copper, as well as because of its numerous civilian and domestic uses, which are less important in the Soviet Bloc than in the democracies.

Intelligence estimates of aluminum consumption in the USSR and the Satellites vary widely. A State Department report indicates that consumption is 90 percent military or paramilitary, with consumer goods taking 1,000 metric tons annually and industrial consumption less than 20,000 metric tons. 63/ Other estimates and reports give widely varying consumption patterns and quantities. 64/ Since such a lack of accurate information was encountered, the approach was taken of obtaining estimated aluminum consumptions by various consuming industries, adding a more or less arbitrary factor based on the assumption that estimates of a particular industry would tend to underestimate rather than overestimate aluminum consumption, and totaling the results. Results are indicated in Table 7.

Table 7

Consumption of Aluminum in the Soviet Bloc
in the Fiscal Year 1952-53 65/

Industry	Thousand Metric Tons	Percent
Iron and Steel	12.5	5.4
Transportation	25.0	10.9
Electrical and Production Tool Industries	42.0	18.3
Military	100.0	43.6
Household uses	25.0	10.9
Other	25.0	10.9
Total	229.5	100.0

In the absence of definite information, determining the consumption pattern for aluminum is difficult, because it is consumed in many industries and locations. This is in contrast to determining production, because aluminum is produced in relatively few plants and its production may be estimated by comparison with known technological information. The approach taken above is believed to be the best available under the circumstances but is subject to wide error.

B. Trade in Aluminum.

There are no records or reports available which indicate that the USSR or the Satellite countries are exporting aluminum.

Comparatively little is known about details of intra-Bloc trade in aluminum. The USSR is reported to be a supplier of aluminum to East Germany 66/ and Poland. 67/ Hungary is reportedly a supplier of aluminum to the USSR. 68/ Information on intra-Bloc trade is so incomplete that a detailed picture cannot be assembled. It appears, however, that the USSR is willing to supply aluminum to Satellites which are deficient in this metal but is willing to do so only in case the aluminum is used for military or paramilitary products, some of which are probably returned to the USSR. Where aluminum can be extracted from the Satellites, this is being done. Projected plans for aluminum industries in the various Satellite countries will make them independent of Soviet deliveries, if accomplished.

V. Reserves.

The position of the Soviet Bloc as to aluminum in the fiscal year 1952-53 is shown in Table 8.

Table 8

Balance Statement of Aluminum in the Soviet Bloc
1952-53

	Thousand Metric Tons
Primary Aluminum Production and Old Scrap	300.0
Imports	17.0 a/
Total	317.0
Exports	Negligible
Consumption	229.5 69/
Reserve	87.5
Total	317.0

a. Same figure as for 1951, used arbitrarily.

The estimated aluminum reserve of the USSR and Satellite countries is indicated in Table 9.*

* Table 9 follows on p. 20.

Table 9

Estimated Aluminum Reserve in the Soviet Bloc
June 1953

	Thousand Metric Tons
Estimated Total Reserve, June 1952	295.0 a/
Reserve Accumulated, June 1952 to June 1953	87.5
Total	382.5

a. Estimated correct within plus or minus 25 percent.

The fact that an aluminum reserve is being built up in the USSR is indicated by a number of prisoner-of-war (PW) reports. One report indicates that 50,000 metric tons of aluminum were stored in a warehouse in Moscow. 70/ Other PW reports estimate varying amounts of aluminum stored. 71/ Data obtained through these sources are so fragmentary that no independent check of reserves of aluminum has been possible, but the number of reports indicates that aluminum reserves do exist. The reserves of aluminum estimated to be available to the Soviet Bloc are not surprising when considered from the point of view of US reserve objectives and war requirements. The Munitions Board estimates US requirements for mobilization to be more than 2 million short tons of aluminum in the first year, rising to more than 3 million short tons by the third year, and suggests a reserve objective of 3 million short tons. 72/

That the Soviet Bloc is able to accumulate a reserve of aluminum and still is importing aluminum from the West may appear to be contradictory. Since the USSR was short of aluminum during World War II, and since its aluminum industry is relatively vulnerable from the standpoint of electrical equipment, if not from location, it would not be surprising if the Soviet Bloc aluminum reserve were built up to an amount sufficient to support a full-scale war for a considerable length of time.

VI. Limitations and Vulnerabilities.

A. Limitations.

The limiting factors in the aluminum industry in the Soviet Bloc are confined to possible shortages of manufacturing equipment, electric power, and the amount of money available to fulfill input requirements. There are no shortages of raw materials or technical ability.

B. Vulnerabilities.

An aluminum reduction industry is extremely vulnerable from the point of view of supply of electrical energy, and even a short cutoff in electric power is disastrous. If the aluminum melt cools or freezes in the potline, the partially refined aluminum must be chipped out before production can be resumed. Since an estimated 75 percent of Soviet Bloc aluminum is produced by electric power generated in vulnerable thermal plants, it is believed, therefore, that the electric power plants and the transmitting, switching, and rectifying electrical equipment are the most vulnerable segments of the aluminum industry. Adequate supplies of raw materials and facilities for producing manufacturing equipment exist within the Bloc. Export controls and preclusive buying of some types of equipment or material, the usual cold war restrictive processes, are not, therefore, applicable.

VII. Conclusions.

It is concluded that the Soviet Bloc is presently producing enough aluminum for military and war-supporting industries and household uses plus some for reserve purposes. That the Russians do not consider the amount produced in the Bloc to be sufficient is indicated by legal and illegal purchases of aluminum from the West, by reported restrictions on uses and shortages in the Bloc, and by the tremdndous expansion which is planned for the aluminum industry in the Bloc.

Enough technical knowledge and raw materials are available for any expansion desired. It is believed, however, that any great expansion would cause a strain on the present Soviet Bloc economy.

The anticipated aluminum industry expansion in the Satellite countries indicates that the USSR intends that the Satellites become independent of the USSR insofar as aluminum production is concerned. Production of aluminum in the Satellites will not be particularly cheap or efficient but will relieve the Soviet economy of the strain of producing the metal.

The USSR has rapidly swung to the use of Hungarian bauxites, and it is believed that Hungary now supplies an amount of bauxite equal to about half of the total European Bloc requirements. This development would tend to increase Soviet plant capacity and reduce costs because of the higher grade of the Hungarian bauxites. The USSR is probably cutting back on its own bauxite mining and probably is mining only the higher-grade bauxite deposits.

In the future, with development of large hydroelectric projects, the cost of aluminum production in the USSR and its strain on the general economy will be considerably reduced.

APPENDIX A

METHODOLOGY

The estimates of availability of production of primary and secondary aluminum in the Soviet Bloc are based on the review of hundreds of sources and a plant-by-plant survey of the Soviet and European Satellite aluminum plants. More information is available on the Satellite than the Soviet plants, and thus the estimates for the former are considered more firm or are accurate within a narrow margin of error. Consumption estimates for the Bloc are less firm than production estimates because of the lack of positive data on USSR consumption later than 1934. They are believed, however, to be satisfactory.

APPENDIX B

GAPS IN INTELLIGENCE

Reasonably accurate information is available on sources and reserves of aluminum ore in the Soviet Bloc. The largest gaps are information concerning accurate figures on current output, inputs, consumption, capacity, and the degree of completion of the expansion program of the aluminum manufacturing industry.

APPENDIX C

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

Reports of the Department of State, ONI, and other government agencies are considered to be the most valuable sources. When these reports are concurred with what was actually seen by a US observer, they are considered to be factually accurate.

Defectors' reports are considered to be next in importance to the US Government agencies' reports and a step above reports of informants. Care must be taken, however, to consider the background of the defector in evaluating the report.

Informants' reports are of variable reliability and must be compared with other sources of information. The informants' reports cited in this report, however, are believed to be fairly reliable.

Prisoner-of-war reports are valuable only when a great many are available on a given plant, locality, or subject. Without supporting evidence of a number of prisoner-of-war reports or of other corroborating information, this type of report is of little value.

Soviet and Satellite press reports can be used only as a general background information and are not considered of value as basic source data.

2. Sources.

Evaluations, following the classification entry and designated "Eval.," have the following significance:

A - Completely reliable	1 - Confirmed by other sources
B - Usually reliable	2 - Probably true
C - Fairly reliable	3 - Possibly true
D - Not usually reliable	4 - Doubtful
E - Not reliable	5 - Probably false
F - Cannot be judged	6 - Cannot be judged

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